



# EmCAL Installation Procedure

PHENIX Procedure No. PP-2.5.2.9/01

Revision "C"

Date: 6/30/99

## Hand Processed Changes

<u>HPC #</u>	<u>Date</u>	<u>Page #'s</u>	<u>Initials</u>
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*PHENIX SE & I*

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*EmCal Subsystem*

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*PHENIX Safety*

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*RHIC Safety*

## **1.0 Purpose & Scope**

**REVISION CONTROL SHEET**

<b>LETTER</b>	<b>DESCRIPTION</b>	<b>DATE</b>	<b>WRITTEN BY</b>	<b>APPROVED BY</b>	<b>CURRENT OVERSIGHT</b>
A	First Issue	No info available	n/a	n/a	n/a
B	Revisions not recorded	9/22/1998	n/a	(4 unintelligible)	n/a
C	Revisions not recorded	6/30/1999	n/a	n/a	n/a
RETIRED	Installation Complete	3/7/2007	D. Lynch	D.Lynch, P. Giannotti, R. Pisani for the PHENIX experiment	D.Lynch

- 1.1 The purpose of this procedure is to provide directions for rigging the four EmCal Sectors onto the carriages in Bldg. 1008. There are five separate sections to this procedure, each covering the installation of different EmCal Sectors:

Section 7.1: PbSc Sector “0”

Section 7.2: PbSc Sector “1”

Section 7.3: PbSc Sectors “2” & “3”

Section 7.4: PbGl Sector “0”

Section 7.5: PbGl Sector “1”

Note that each PbSc Sector weighs 20-tons while the PbGl’s weigh 21.5-tons each.

## **2.0 Responsibilities**

- 2.1 All operations shall be performed under the direction of the Phenix Experimental Hall “Person-in-Charge” or his designee.
- 2.2 Due to the delicacy of interior detector components and their value, as well as the inherent personnel risk involved in handling such large objects, this procedure and all relevant BNL safety guidelines must be strictly adhered to. In accordance with BNL policy, any individual may cease operations if they in any way feel unsafe or if they believe unsafe procedures are being followed. Such a complaint shall be reviewed by the cognizant engineer, and if necessary, BNL ES & H Services.

## **3.0 Prerequisites**

- 3.0 Training: All personnel involved in this procedure shall have reviewed this procedure, and be fully knowledgeable about the way in which the EmCal Sectors mount to the carriage. All personnel shall sign an acknowledgement sheet to that effect.
- 3.1 All personnel involved in this procedure must have a current BNL Safety Awareness Certificate (SAC).
- 3.2 All personnel involved in this procedure shall wear hard hats in accordance with RHIC SEAPPM 1.16.0.
- 3.3 Personnel involved in this procedure shall wear safety shoes.

## **4.0 Precautions**

- 4.1 Visitors shall not be permitted in the PEH during these procedures.
- 4.2 The area where rigging operations will be performed shall be cordoned-off to all personnel except for the Person-in-Charge and the three technicians assigned to perform this procedure. Others may enter the area only with the specific approval of the Person-in-Charge.
- 4.3 Some operations will require personnel to work in close proximity to suspended loads. Do not permit yourself or anyone else to be positioned under the load.

## **5.0 Equipment List**

- 5.1 The following equipment & hardware is called for in various sections of this procedure:

30-ton EmCal lift beam, Serial No. 92724

M-24 swivel eyes, 3-ton capacity (4)

9.5-ton shackles (2)

17-ton shackles (2)

Swivel-eyes: 3-ton capacity (4)

2-ton capacity (4)

Chainhoists: 5-ton capacity (2)

2-ton capacity (2)

Slings: 15-ton capacity, 2'6" long (2)

10-ton capacity (4)

5-ton capacity (2)

3-ton capacity (2)

2-ton capacity (3)

## **6.0 Preparations**

- 6.1 The sector mounts on the carriages shall have been previously surveyed to their correct positions in accordance with Phenix Dwg. No. 002-0510-006, Rev. A.
- 6.2 The carriage mounting plate bolts (1"-8) shall be torqued to 680 ft-lb.
- 6.3 Bolt the carriage stops to the assembly hall rails at the four corners of the carriage in the direction of Hilman Roller travel.
- 6.4 Remove the trunnion keeper-bars from the carriage mounting brackets.

## **7.0 Procedure**

### **7.1 *Sector "0" (PbSc, Lower Sector)***

- 7.1.1 Verify that the five 1"-8 bolts attaching the lifting trunnions to the EmCal frame have been torqued to 300 ft-lb.
- 7.1.2 Attach the yellow 30-ton EmCal lift beam to the Sector using the 40-ton crane hook and the gray, 2'6" long, 15-ton slings. Slings to be configured for a "vertical" lift. See Figure 1.
- 7.1.3 Slowly lift the EmCal Sector. When the load has been taken onto the crane, unbolt the two feet from the frame so that they can be removed using a forklift. When the Sector is hanging freely from the crane it will be at roughly a 24-degree angle to vertical. See Figure 1.
- 7.1.4 Move the Sector to the carriage and place it in its upper mounting brackets. When resting freely in the carriage, the sector will hang at roughly a 7.5-degree angle to vertical. See Figure 2-2.
- 7.1.5 Have at least TWO people visually verify that the EmCal trunnions are sitting properly within the mounting brackets.
- 7.1.6 Disconnect the beam and slings.
- 7.1.7 Install two swivel-eyes, minimum 3-ton capacity, in the holes drilled in the vertical towers of the carriage.
- 7.1.8 Remove the upper lifting trunnions which were installed in Step 7.1.1 from the frame. Install two swivel-eyes, minimum 3-ton

capacity, in the lower lifting trunnion mounting holes (one per side).

- 7.1.9 Install swivel eyes (4), minimum 3-ton total capacity per side, in the holes on the bottom of the EmCal frame which were previously used for attaching to the feet.
- 7.1.10 Attach two chainhoists, minimum 5-ton capacity each, between the two pairs of swivel-eyes installed in Steps 7.1.7 & 7.1.8. Install a 5-ton capacity sling in series with the chainhoist at each location (to help with load equalization).

**WARNING:**

***A TOTAL FORCE OF 4.8-TONS WILL BE REQUIRED TO ROTATE A PbSc SECTOR (20-TONS) TO ITS FINAL POSITION AT 22.5-DEGREES. SEE FIGURE 5 FOR SAMPLE CALCULATION.***

- 7.1.11 Work the two chainhoists in concert to draw the Sector forward, rotating it into its final position within the lower mounting bracket. PERSONNEL ARE NOT PERMITTED NEAR THE BACK SIDE OF THE EMCAL FRAME DURING THIS OPERATION.
- 7.1.12 With the Sector in its final position, attach two slings, minimum 3-ton capacity each, between the swivel-eyes installed on the bottom of the sector (Step 7.1.9) and the two carriage lifting weldments on the front face of the carriage.
- 7.1.13 Bolt the two keeper-bars to the back of the lower brackets. Torque the bolts (1"-8) to 100 ft-lb. NO UNNECESSARY PERSONNEL ARE TO BE PERMITTED ON THE BACK SIDE OF THE EMCAL DURING THIS OPERATION.
- 7.1.14 Clear all personnel from the back side of the Sector.
- 7.1.15 Remove the two slings which were installed in Step 7.1.12.
- 7.1.16 Slowly release the load from the two chainhoists and disconnect them.
- 7.1.17 Remove all swivel-eyes.

**7.2 Sector "1" (PbSc, Vertical Sector)**

- 7.2.1 Verify that the five 1”-8 bolts attaching the lifting trunnions to the EmCal frame have been torqued to 300 ft-lb.
- 7.2.2 Attach the yellow 30-ton EmCal lift beam to the Sector using the 40-ton crane hook and the gray, 2’6” long, 15-ton slings. Slings to be configured for a “vertical” lift. See Figure 1.
- 7.2.3 Slowly lift the EmCal Sector. When the load has been taken onto the crane, unbolt the two feet from the frame so that they can be removed using a forklift. When the Sector is hanging freely from the crane, it will be at roughly a 24-degree angle to vertical. See Figure 1.
- 7.2.4 Move the Sector to the carriage and place it in its upper mounting brackets. When resting freely in the carriage, the sector will hang at roughly a 7.5-degree angle to vertical. See Figure 3-2.
- 7.2.5 Have at least TWO people visually verify that the EmCal trunnions are sitting properly within the mounting brackets.
- 7.2.6 Disconnect the beam and slings.
- 7.2.7 Install two swivel-eyes, minimum 2-ton capacity each, in the holes drilled in the forward arms of the carriage.
- 7.2.8 Remove the lifting trunnions which were installed in Step 7.2.1 from the frame. Install two swivel-eyes, minimum 2-ton capacity, in the lower-most lifting trunnion mounting holes (one per side).
- 7.2.9 Attach two chainhoists, minimum 2-ton capacity each, between the two pairs of swivel-eyes. Install a 2-ton sling in series with each chainhoist (to help equalize loads) See Figure 4.
- 7.2.10 Wrap a sling, minimum 2-ton capacity, horizontally around the body of the EmCal frame. The ends of the sling pass between the frame and the carriage towers, attaching to the forward arms of the carriage.

**WARNING:**

***A TOTAL FORCE OF 1.3-TONS WILL BE REQUIRED TO ROTATE A PbSc SECTOR TO ITS INSTALLED VERTICAL POSITION.***

**CAUTION:**

***THERE IS ONLY A 4-mm CLEARANCE BETWEEN THE LOWER TWO SECTORS WHEN FULLY INSTALLED. MONITOR THIS CLEARANCE CLOSELY AS THE VERTICAL SECTOR ROTATES INTO POSITION. STOP IMMEDIATELY IF THERE IS ANY DANGER OF DIRECT CONTACT BETWEEN THE TWO SECTORS.***

7.2.11 Work the two chainhoists in concert to draw the Sector forward, rotating it into its final position within the lower mounting bracket. PERSONNEL ARE NOT PERMITTED NEAR THE BACK SIDE OF THE EMCAL FRAME DURING THIS OPERATION.

7.2.12 With the Sector in its final position, tighten the sling which was installed in Step 7.2.10 so that in the event of a slip in the chainhoists, it holds the Sector securely in place.

7.2.13 Bolt the two keeper-bars to the back of the lower brackets. Torque the bolts (1"-8) to 100 ft-lb. NO UNNECESSARY PERSONNEL ARE TO BE PERMITTED ON THE BACK SIDE OF THE EMCAL DURING THIS OPERATION.

7.2.14 Clear all personnel from the back side of the Sector.

7.2.15 Remove the sling.

7.2.16 Slowly release the load from the two come-alongs and disconnect them.

7.2.17 Remove all swivel-eyes.

### ***7.3 Sectors "2" & "3" (PbSc, Upper Sectors)***



- 7.3.1 Transfer the Sector from the normal stands to those with rocker-feet.
- 7.3.2 Verify that the 1"-8 bolts attaching the triangular PbSc lifting plates to the EmCal frame have been torqued to 300 ft-lb.
- 7.3.3 Attach the lifting trunnions on the yellow 30-ton EmCal lift beam to the triangular attachment plates using the 40-ton crane hook. See Figure 6-1.
- 7.3.4 Slowly lift the EmCal Sector, rolling gently forward onto the rocker-feet (Figure 6-2). When the load has been taken onto the crane, unbolt the two feet from the frame so that they can be removed using a forklift. When the Sector is hanging freely from the crane, it will be at roughly a 55-degree angle to vertical. See Figure 7-1.
- 7.3.5 Move the Sector to the carriage and place it in its upper mounting bracket. See Figure 7-2.

**CAUTION:**

***THERE IS ONLY A 4-mm CLEARANCE BETWEEN THESE TWO SECTORS WHEN FULLY INSTALLED. MONITOR THIS CLEARANCE CLOSELY AS THE SECTOR ROTATES INTO POSITION. STOP IMMEDIATELY IF THERE IS ANY DANGER OF DIRECT CONTACT BETWEEN THE TWO SECTORS.***

- 7.3.6 Lower the crane until the Sector engages its lower mounting bracket. See Figure 7-3. Ensure that the crane follows the hook in order to minimize horizontal loads.
- 7.3.7 Have at least TWO people visually verify that the EmCal trunnions are sitting properly within the mounting brackets.
- 7.3.8 Disconnect the triangular attachment plates from the EmCal frame and remove along with the lifting beam.
- 7.3.9 Bolt the two keeper-bars to the back of the support brackets. Torque the bolts (1"-8) to 100 ft-lb.

## **7.4 Sector "0" (PbGl, Lower Sector)**

***Note: Rigging clearances between the EmCal Sector & the Carriage Support Plates is extremely tight and may require the temporary removal of support plates or hardware in order to allow the Sector to clear.***

- 7.4.1 Verify that the five 1"-8 bolts attaching the lifting trunnions to the EmCal frame have been torqued to 300 ft-lb.
- 7.4.2 Verify that the eight 1"-8 bolts attaching the PbGI lifting plates to the EmCal frame have been torqued to 300 ft-lb.
- 7.4.3 Loop two 10-ton slings (20-ft. long) directly over the 40-ton crane hook and connect to the EmCal attachment plates using 17-ton, 9.5-ton, and 17-ton shackles, connected in series at the plate.
- 7.4.4 Attach two 10-ton slings (20-ft. long) to the 40-ton crane hook using the 2'6", 15-ton sling, choked configuration, in series with a 9.5-ton shackle. Loop the opposite end directly over the EmCal lifting trunnions.
- 7.4.5 Slowly lift the EmCal Sector. When the load has been taken onto the crane, unbolt the two feet from the frame so that they can be removed using a forklift. When the Sector is hanging freely from the crane, the upper support trunnion should be "leading" the lower trunnion just slightly (entire frame rotated slightly counterclockwise).
- 7.4.6 Move the Sector to the carriage and place it in its upper mounting brackets.
- 7.4.7 Have at least TWO people visually verify that the EmCal trunnions are sitting properly within the mounting brackets.
- 7.4.8 Install two swivel-eyes, minimum 3-ton capacity each, in the holes drilled in the vertical towers of the carriage.
- 7.4.9 Install two swivel-eyes, minimum 3-ton capacity each, in the 1"-8 holes drilled in the lower sides of the EmCal frame (specifically drilled for this purpose).
- 7.4.10 Attach two chainhoists, minimum 5-ton capacity each, between the two pairs of swivel-eyes installed in Steps 7.4.8 & 7.4.9. Install a 5-ton capacity sling in series with the chainhoist at each location (to help with load equalization).

- 7.4.11 Wrap a sling, minimum 6-ton capacity, horizontally around the body of the EmCal frame. The ends of the sling pass between the frame and the carriage towers, attaching to the forward arms of the carriage.

**WARNING:**

***A TOTAL FORCE OF 5.2-TONS WILL BE REQUIRED TO ROTATE A PbGI SECTOR (21.5-TONS) TO ITS FINAL POSITION AT 22.5-DEGREES. SEE FIGURE 5 FOR SAMPLE CALCULATION.***

- 7.4.12 Work the two chainhoists in concert to draw the Sector forward, rotating it into its final position within the lower mounting bracket. PERSONNEL ARE NOT PERMITTED NEAR THE BACK SIDE OF THE EMCAL FRAME DURING THIS OPERATION.
- 7.4.13 Bolt the two keeper-bars to the back of the lower brackets. Torque the bolts (1"-8) to 100 ft-lb. NO UNNECESSARY PERSONNEL ARE TO BE PERMITTED ON THE BACK SIDE OF THE EmCAL DURING THIS OPERATION.
- 7.4.14 Clear all personnel from the back side of the Sector.
- 7.4.15 Remove the sling which was installed in Step 7.4.11.
- 7.4.16 Slowly release the load from the two chainhoists and disconnect them.
- 7.4.17 Disconnect from the 40-ton crane hook. Remove the upper lifting trunnions, PbGI attachment plates, and swivel-eyes.

## **7.5 Sector “1” (PbGl, Vertical Sector)**

***Note: Rigging clearances between the EmCal Sector & the Carriage Support Plates is extremely tight and may require the temporary removal of support plates or hardware in order to allow the Sector to clear.***

- 7.5.1 Verify that the five 1”-8 bolts attaching the lifting trunnions to the EmCal frame have been torqued.to 300 ft-lb.
- 7.5.2 Verify that the eight 1”-8 bolts attaching the PbGl lifting plates to the EmCal frame have been torqued to 300 ft-lb.
- 7.5.3 Attach the yellow 30-ton EmCal lift beam to the Sector using the 40-ton crane hook, two 10-ton slings (basketed configuration) and two 9.5-ton shackles. The slings are basketed over the lift beam, attaching to the shackle at the attachment plate, and directly to the lifting trunnion at the other end.
- 7.5.4 Slowly lift the EmCal Sector. When the load has been taken onto the crane, unbolt the two feet from the frame so that they can be removed using a forklift. When the Sector is hanging freely from the crane, the upper support trunnion should be “leading” the lower trunnion just slightly (entire frame rotated slightly counterclockwise).
- 7.5.5 Move the Sector to the carriage and place it in its upper mounting brackets.
- 7.5.6 Have at least TWO people visually verify that the EmCal trunnions are sitting properly within the mounting brackets.
- 7.5.7 Bolt the two keeper-bars to the back of the lower brackets. Torque the bolts (1”-8) to 100 ft-lb.
- 7.5.8 Disconnect the beam and slings.
- 7.5.9 Remove the upper lifting trunnions and PbGl attachment plates which were installed in Steps 7.5.1 & 7.5.2.